Age and Environment of a Marine Terrace Fauna, San Clemente Island, California

BY

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(4 Text figures)

INTRODUCTION

San Clemente Island, the southernmost of the California Channel Islands (Figure 1a), is well known for its striking step-like series of marine terraces extending from near sea level to the top of the island. As early as 1893, Lawson (1893: p. 131) measured with an aneroid barometer the elevation of 19 terraces ranging from 12 to 1500 feet above sea level. Later, Smith (1898: p. 475) recorded 23 terraces between 12 and 1365 feet. Emery (1960: pp. 7, 35), using published topographic maps, estimated the elevations of 16 terraces from about 50 to 1925 feet above sea level and listed about 7 submarine terraces down to nearly 600 feet below sea level.

Many of these terraces are devoid of marine deposits and thus fossils are rarely found. Smith (1898: p. 476) reported a single species, the pelecypod *Lucina californica* Conrad, from an unspecified locality, and later Cockerell (1939) listed 33 molluscan species from a terrace deposit at about 800 feet in elevation. Fossils have not been previously recorded from lower terraces. The present paper records a marine fauna, predominantly foraminifera, ostracods and mollusks, collected from a terrace about 80 feet above sea level at Horse Cove near the southern end of the island.

GEOLOGIC SETTING

San Clemente Island is composed largely of Miocene volcanic rocks with some interbedded marine sediments (Olmsted, 1958: pl. 1). At Horse Cove the area is underlain by Miocene diatomite and pumice breccia which overlie and are faulted against andesite. On this part of the island marine terraces are numerous and their form well preserved, but sediment and fossils are not commonly exposed on them due to burial by alluvium, or are not present because they have apparently been removed by erosion. However, on one terrace surface marine fossiliferous sediment is exposed at an elevation of about 80 feet (Figure 1b). This exposure was traced laterally several hundred feet, but shells from overlying Indian kitchen middens contaminate the fossiliferous outcrops except at one locality (UCLA 4936). The shoreline angle of the terrace lies about 200 feet north of this locality at an elevation of about 100 feet (Figure 1b).

At the fossil locality, the marine terrace deposits, which consist of boulder- to sand-sized clasts, lie on Miocene diatomite. These terrace sediments are extremely well cemented so that removal of fossils is very difficult. The deposit is overlain by 2 - 3 feet of alluvium, which consists of soil and volcanic clasts up to several feet across (Figure 2).

PALEONTOLOGY

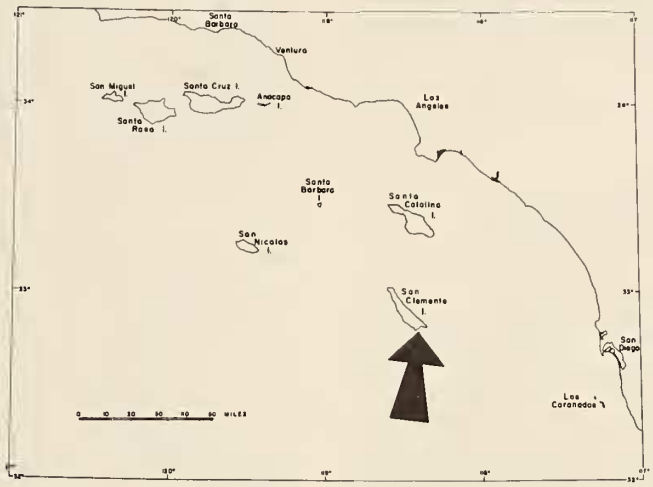
The fauna collected from the Horse Cove locality includes 18 species of foraminifera, 16 gastropods, 4 pelecypods, 2 echinoids, 8 ostracods, a cetacean, and several unidentified species of bryozoa.

Figure 1

A. Southern California Channel Islands.

(The arrow indicates the Horse Cove area at the southern end of San Clemente Island.)

B. Horse Cove area, San Clemente Island showing the collecting locality (UCLA 4936) in Pleistocene marine terrace sediments. The approximate position of the former shoreline associated with the deposits is indicated by the dashed line.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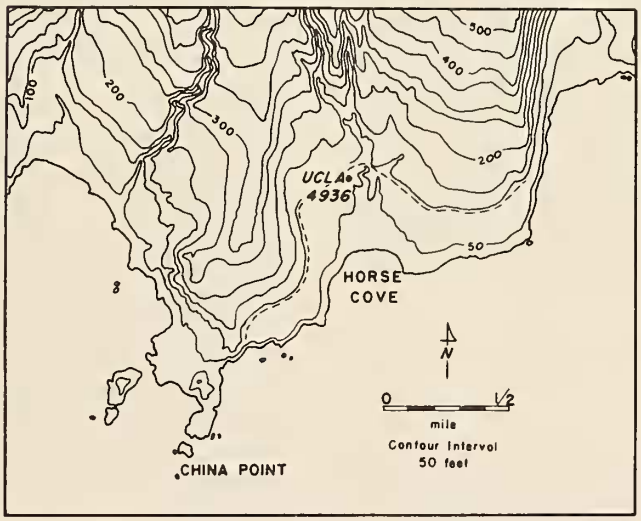
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B

FORAMINIFERIDA

Foraminiferal faunas from marine terrace sediments in California have not been studied previously in detail, yet foraminifera commonly occur in these sediments. A few species of foraminifera have been recorded incidental to studies of other terrace problems, but no fauna has been adequately described. Foraminifera probably have been ignored in terrace deposits because they mostly occur in coarse-grained sediments. This necessitates much searching without encouraging results and the specimens so obtained are generally worn and leached. Furthermore, reworking of geologically older forms into the deposits is common. Mollusks are more apparent and therefore have been utilized previously in solving terrace problems. However, having proved useful in age dating and correlation of older rocks, and for determining past and present environmental factors, foraminifera should provide a rich source of data which will assist in interpreting the significance of terraces and their deposits. Therefore, I have documented this foraminiferal fauna as completely as possible.

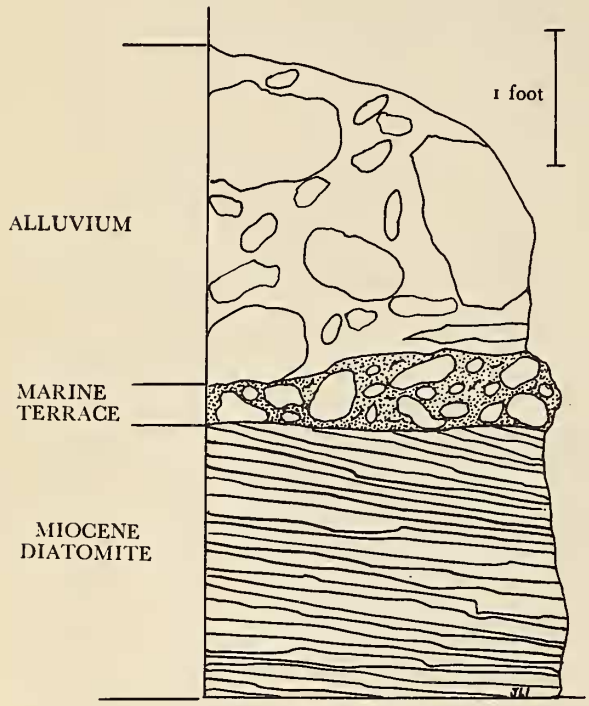


Figure 2

Columnar Section of Rock Units exposed at UCLA 4936.

In order to find foraminifera, terrace sediment, excluding the larger clasts, was soaked in kerosene, and then boiled in water, washed over a 200 mesh Tyler screen (openings 74μ) and dried. The dry sediment, mostly sand, was shaken into a heavy liquid to separate the foraminifera from the sand by flotation. The light residue consisted mostly of fossils or their fragments, and the heavy fraction was mostly sand. The sand was searched to determine if all foraminifera had floated, but many additional ones were found in it.

An attempt to compile data on the geographic distribution of the species found at Horse Cove was undertaken from the literature. These ranges could not be accepted as completely valid because of some published misidentifications of species. A critical study of ranges would require re-examination of the specimens on which the identifications were based and a study of collections from many places at different depths along the coast of the Americas.

The foraminiferal fauna collected at Horse Cove is a small one consisting mostly of intertidal and near-shore forms. All species have been recorded as living both to the north and south of San Clemente Island, and have age ranges spanning the Pleistocene. Some, nevertheless, are probably reworked from the underlying Miocene rocks; these are indicated under "Fauna" below.

MOLLUSCA

The small molluscan fauna obtained appears to be a mixture of several different life associations. All of the species live today in both protected and exposed coastal areas, except *Macoma secta* and *Saxidomus nuttalli* which are generally restricted to protected environments. All species are common in littoral zones except *Mitrella tuberosa* and *Epitonium indianorum* which live below the zone of heavy surf action. All of the species have Recent geographic ranges which include the latitude of San Clemente Island. Two species, *Epitonium indianorum* and *Lacuna carinata,* have ranges which end just south of San Clemente Island, and another one, *Haliotis fulgens,* is more abundant in the warmer waters off Baja California and is uncommon north of Point Conception, California.

OSTRACODA

"At least 8 species of Ostracoda are present in the collection, six of which can be assigned to species previously recorded from the Pleistocene of southern California. One of these species, *Hermanites kewi,* is not reported as living. The remaining 5 species are known to be members of the Recent fauna and to include southern California in their living ranges. They all occur at Bahia Todos Santos, for which Benson (1959) has given an account of the

distribution patterns of marine ostracods. The species at hand are members of Benson's 'Biofacics I', which occurs on shallow bottoms of fine and medium sand at marine salinities around the northern margin of the bay and around Islas de Todos Santos and Punta Banda. Evidently the members of this biofacies have rather similar habitat preferences off Los Angeles (Rothwell, 1944, *fide* Benson, 1959). The fossil collection most closely resembles associations from the outer parts of biofacies I, especially stations at Bahia Todos Santos where *Hemicythere californica* is rare or absent." (J. W. Valentine, *in litt.*)

OTHER INVERTEBRATES

The echinoid *Dendraster* lives today on sand or mud substrates subtidally or in protected tidal areas. The bryozoa are attached forms requiring a firm substrate.

PALEOECOLOGY

The difficulties of making paleoecologic interpretations of Pleistocene faunas at San Nicolas Island have been summarized by Vedder & Norris (1963: p. 53) and these also apply to the interpretation of faunas from San Clemente Island. Nevertheless, some inferences are justified. The depositional environment can be inferred from the character of the sediments, the fauna, and the position of the locality with respect to the former shore line.

As evidenced by the topography and the configuration of the ancient shore line, deposition occurred in a small cove extending northward about ¾ mile into the shore (see Figure 1 b). On the west side of the cove a rocky, volcanic headland projected southward, and on the east the shore line gently curved southward. The headland apparently provided sufficient shelter from currents and wave action to create a semi-protected environment, which enabled the protected-coast elements to survive. The bottom of the cove was floored with sand and interspersed boulders. These sediments provided the substrates required for both the burrowing forms and rocky-shore elements. The sub-tidal species of mollusks and foraminifera indicate that deposition may have taken place below the surf zone, although shoreward transportation of such species may occur (Valentine, 1961: p. 348). These species, which commonly live below the zone of active surf, may have been able to move into water shallower than normal because of decreased wave action in this sheltered area. The fossil locality is 20 feet lower in elevation than the shore line angle indicating that the depth of water at the time of deposition was not more than about 20 feet.

All of the species found could be expected to live at San Clemente Island today. The several predominantly northern or southern elements in the fauna are not unusual for the Channel Islands, for these elements overlap in the region today because of hydrographic conditions which permit both warmer and cooler sea-surface temperatures locally than along the mainland (Valentine, 1961: p. 345). These elements in the fossil fauna suggest that similar conditions were existent during the life-time of the fauna.

AGE AND CORRELATION

Problems of age dating and correlation of marine terraces above sea level in California have been summarized by Lipps (1964: p. 1174) and Vedder & Norris (1963: pp. 52 - 53). These problems prevent definite correlations and dating of the San Clemente Island terrace at Horse Cove.

All fossils found, except *Hermanites kewi,* range in age from at least near the beginning of the Pleistocene to the present and thus are of no help in determining the age of the deposit. Most marine terraces above sea level on the mainland have been considered Upper Pleistocene because they truncate Lower Pleistocene beds tilted by the "Mid-Pleistocene orogeny". This appears not to be true for all terraces on the northern Channel Islands, where Valentine & Lipps (1963) interpreted a fauna recovered from a 250-foot terrace as probably of Early Pleistocene age, and where Orr (1960) and Lipps (1964) believed terraces at 100 feet and lower to be of Sangamon or younger age. On San Nicolas Island, faunas from higher terraces contain species (see Vedder & Norris, 1963: table 4) which on the mainland are believed to be Pliocene or Early Pleistocene in age. Thus there seems to be significant age difference between terraces 100 feet and lower and those at higher elevations (see Valentine & Lipps, in press). The only recorded fauna from higher terraces on San Clemente (Cockerell, 1939) is essentially a rocky-shore assemblage without any Early Pleistocene or older elements. However, the small size of this collection (33 species) and the general lack of information concerning the nature of Early Pleistocene rocky-shore faunas does not preclude an Early Pleistocene age for Cockerell's fauna. All known island terrace faunas at lower elevations contain no extinct elements. It has been suggested that the lower terraces may have formed during stands of sea level higher than at present, and that they may be correlative (Emery, 1960: p. 8).

FAUNA

All identified species and specimens referred to genera are listed below, together with references to their original description and present generic assignment. The classification of the Foraminiferida follows Loeblich & Tappan (1964) with certain modifications, that of the Mollusca follows Keen (1963), and that of the Ostracoda follows Moore (1961). The Foraminiferida are illustrated in Text figures 3 and 4.

FORAMINIFERIDA

Miliolidae (family)

Quinqueloculina cf. *Q. akneriana* d'Orbigny, 1846, Foraminifères fossiles du Bassin Tertiaire de Vienne (Autriche), Gide et Comp. (Paris), p. 290; plt. 18, figs. 16 - 21 [Figure 3, nos. 2 a, 2 b]

Quinqueloculina angulostriata Cushman & Valentine, 1930, Contr. Geol. Stanford Univ., vol. 1, no. 1; p. 12; plt. 2, figs. 5 a - 5 c. [Figure 3, nos. 3 a, 3 b]

Quinqueloculina microcostata Natland, 1938, Univ. Calif., Scripps Inst. Oceano. Bull., Tech. Ser., vol. 4; p. 142; plt. 4, figs. 6 a - 6 c [Figure 3, nos. 1 a - 1 c]

Nodosariidae

Lenticulina cushmani (Galloway & Wissler) = *Robulus cushmani* Galloway & Wissler, 1927, Journ. Paleont., vol. 1, no. 1; p. 51; plt. 8, figs. 11 a, 11 b [Figure 3, nos. 11 a, 11 b]

Polymorphinidae

Oolina melo d'Orbigny, 1839, Voyage dans l'Amérique méridionale, Foraminifères, vol. 5, prt. 5; p. 20; plt. 5, fig. 9 [Figure 3, nos. 8 a, 8 b]

Bolivinitidae

Bolivina advena Cushman, 1925, Contr. Cushman Lab. Foram. Research, vol. 1, prt. 2; p. 29; plt. 5, figs. 1 a, 1 b [Figure 3, nos. 5 a, 5 b]

Bolivina sp. [Figure 3, nos. 7 a, 7 b]

Islandiellidae

Islandiella californica (Cushman & Hughes). Nørvang, 1958, Videnskab. meddel. fra Dansk Naturhist. For., Copenhagen, vol. 120; p. 29 = *Cassidulina californica* Cushman & Hughes, 1925, Contr. Cushman Lab. Foram Research, vol. 1, prt. 1; p. 12; plt. 2, figs. 1 a - 1 c [Figure 3, nos. 9 a, 9 b]

Buliminidae

Bulimina sp. [Figure 3, nos. 4 a, 4 b]

Uvigerinidae

Trifarina hughesi (Galloway & Wissler) = *Uvigerina hughesi* Galloway & Wissler, 1927, Journ. Paleont. vol. 1, no. 1; p. 76; plt. 12, figs. 5 a, 5 b [Figure 3, nos. 6 a, 6 b]

Discorbidae

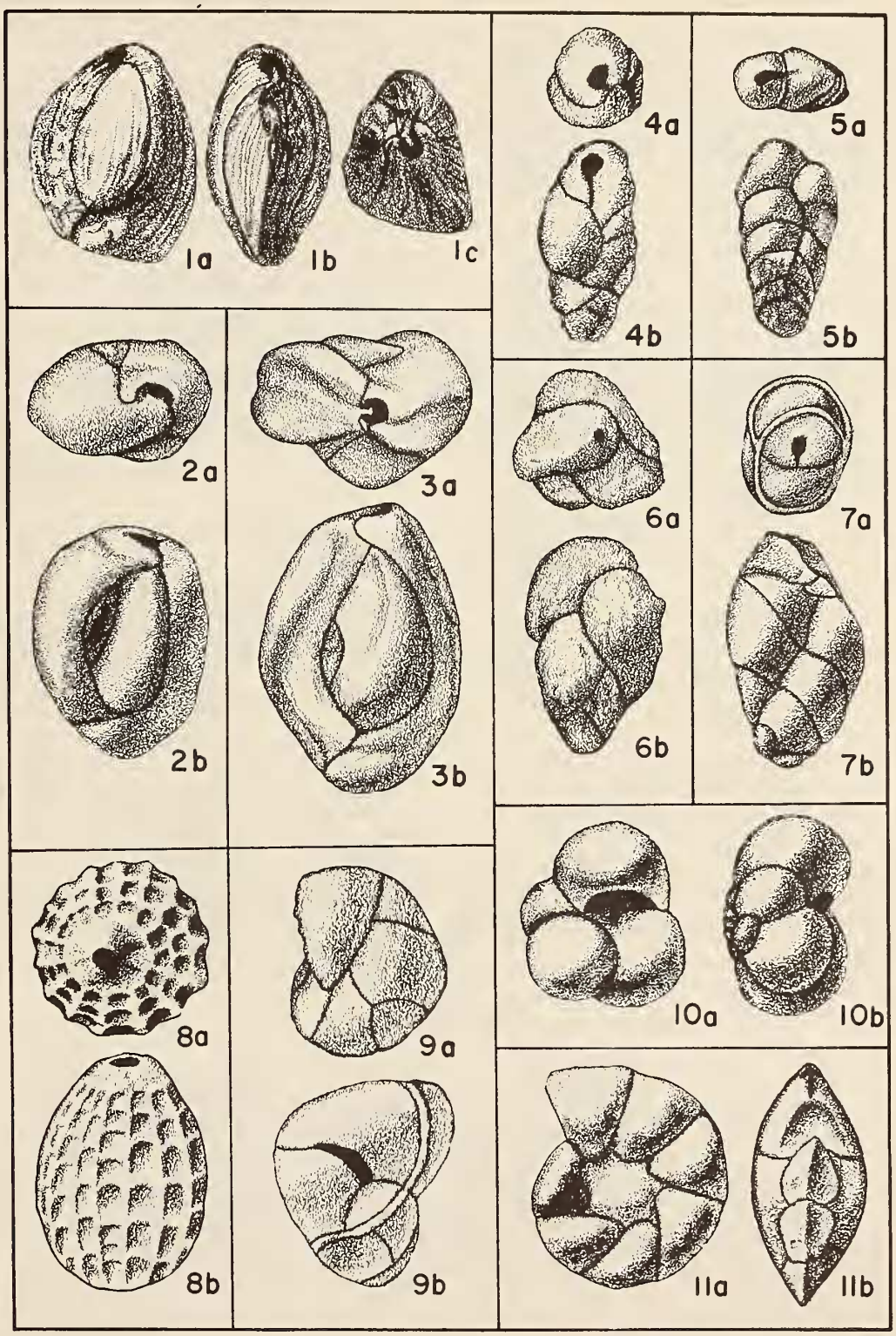
Rotorbinella campanulata (Galloway & Wissler). Douglas & Sliter, 1965, Tulane Stud. Geol., vol. 3, no. 3; p. 153; plt. 1, fig. 1; plt. 6, fig. 6 = *Globorotalia campanulata* Galloway & Wissler, 1927, Journ. Paleont., vol. 1, no. 1; p. 58; plt. 9, figs. 14 a to 14 c [Figure 4, nos. 6 a - 6 c]. Two specimens identical with the original illustrations of *Rotalia turbinata* Cushman & Valentine, 1930, were found in samples from Horse Cove, but Douglas & Sliter (*op. cit.*) stated that this form is one end member of a normal population of *Rotorbinella campanulata.*

Valvulineria cf. *V. glabra* Cushman. Bandy & Arnal, 1957, Amer. Assoc. Petrol. Geol. Bull., vol. 41, no. 9; p. 2053 = *Valvulineria vilardeboana* var. *glabra* Cushman, 1927, Univ. Calif., Scripps Inst. Oceano. Bull., Tech. Ser., vol. 1, no. 10; p. 161; plt. 4, figs. 5, 6 [Figure 4, no. 4]. Miocene ?

Figure 3

Foraminifera from the Pleistocene at Horse Cove (UCLA 4936), San Clemente Island, California.

1. *Quinqueloculina microcostata* Natland. a: side view; b: edge view; c: apertural view. UCLA Hypotype 34143. x 70. 2. *Q.* cf. *Q. akneriana* d'Orbigny. a: apertural view; b: side view. UCLA figured specimen 34141. x 100. 3. *Q. angulostriata* Cushman & Valentine. a: apertural view; b: side view. UCLA Hypotype 34142. x 70. 4. *Bulimina* sp. a: apertural view; b: side view. UCLA figured specimen 34148. x 140. Miocene? 5. *Bolivina advena* Cushman. a: apertural view; b: side view. UCLA Hypotype 34147. x 100. 6. *Trifarina hughesi* (Galloway & Wissler). a: apertural view; b: side view. UCLA Hypotype 34149. x 100. 7. *Bolivina* sp. a: apertural view; b: side view. UCLA figured specimen 34146. x 140. Miocene? 8. *Oolina melo* d'Orbigny. a: apertural view; b: side view. UCLA Hypotype 34145. x 215. 9. *Islandiella californica* (Galloway & Wissler). a: side view; b: apertural view. UCLA Hypotype 34150. x 195. 10. *Globigerina bulloides* d'Orbigny. a: umbilical view; b: side view. UCLA Hypotype 34155. x 100. 11. *Lenticulina cushmani* (Galloway & Wissler). a: side view; b: apertural view. UCLA Hypotype 34144. x 100.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11a
11b

GLABRATELLIDAE

Glabratella sp. [Figure 4, nos. 7a - 7c]. Most species of *Glabratella* have been previously assigned to other genera and little attention has been given to the distinguishing umbilical characters (see SEIGLIE & BERMUDEZ, 1965), thus specific identification is not now possible.

ELPHIDIIDAE

Cribroelphidium poeyanum (D'ORBIGNY). LOEBLICH & TAPPAN, 1964, Treatise Invert. Paleont., Prt. C, Protista 2; p. C635. = *Polystomella poeyana* D'ORBIGNY, 1859, Foraminifères *in* DE LA SAGRA, Histoire Physique et Naturelle de l'Île de Cuba, Paris, p. 55. [Figure 4, nos. 8a, 8b]. BANDY (1963) listed 5 described species as subspecies of *C. poeyanum*, as NATLAND (1950: p. 15) first suggested, and showed that they all occurred in the same environments. As there is no apparent ecologic difference between these subspecies listed by BANDY, and as they seem to intergrade in morphology, they are considered variants of a single species.

GLOBIGERINIDAE

Globigerina bulloides D'ORBIGNY, 1826, Ann. Sci. Nat. Paris, ser. 1, vol. 7; p. 277 [Figure 3, nos. 10a, 10b]

ROSALINIDAE

The genus upon which this family is based, *Rosalina,* has bilamellar rather than monolamellar septa, hence it and its family was removed from the Discorbacea by DOUGLAS & SLITER (1965).

Rosalina globularis D'ORBIGNY, 1826, Ann. Sci. Nat. Paris, ser. 1, vol. 7; p. 271; plt. 13, figs. 1 - 4 [Figure 3, nos. 2a - 2c]. DOUGLAS & SLITER (1965) have shown that various species originally described from the west coast of North America are conspecific with D'ORBIGNY's species.

CIBICIDIDAE

Cibicides fletcheri GALLOWAY & WISSLER, 1927, Journ. Paleont., vol. 1, no. 1; p. 64; plt. 10, figs. 8a - 9c. [Figure 4, nos. 1a - 1c, 3a - 3c]

NONIONIDAE

Pullenia miocenica KLEINPELL, 1938, Miocene stratigraphy of California, Tulsa, p. 338; plt. 14, fig. 6 [Figure 4, nos. 5a, 5b]. Miocene?

GASTROPODA

HALIOTIDAE

Haliotis fulgens PHILIPPI, 1845, Zeitschr. für Malakozool., p. 150

Haliotis rufescens SWAINSON, 1822, Cat. Shells Bligh, appendix, p. 2

TROCHIDAE

Calliostoma supragranosum CARPENTER, 1864, British Assoc. Adv. Sci. Reprt. for 1863, p. 653

EPITONIIDAE

Epitonium indianorum (CARPENTER). DALL, 1917, U. S. Nat. Mus., Proc., vol. 53, no. 2217, p. 477 = *Scalaria indianorum* CARPENTER, 1864, Brit. Assoc. Adv. Sci., Reprt. for 1863, p. 660

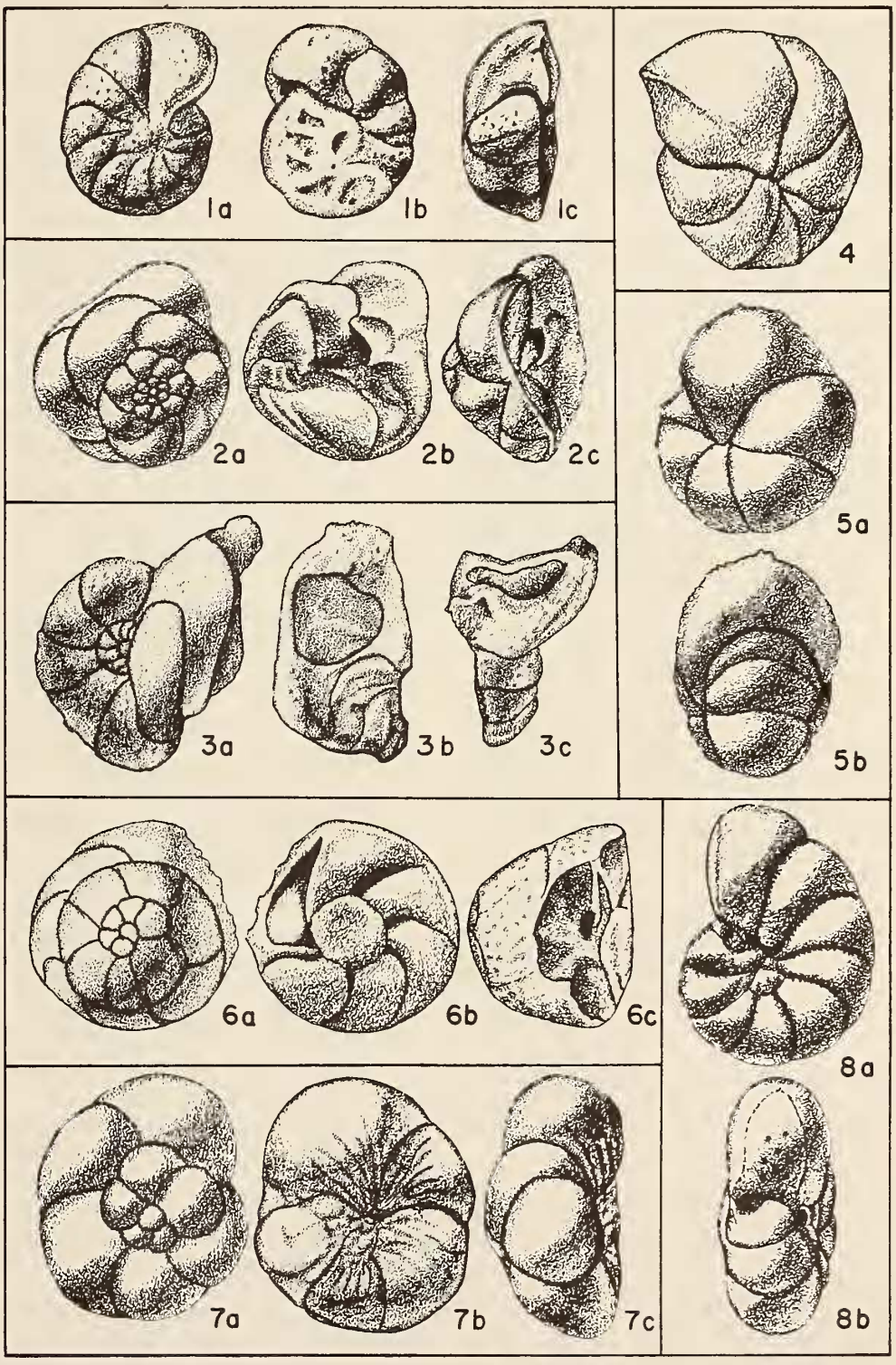
LACUNIDAE

Lacuna carinata GOULD, 1849, Boston Soc. Nat. Hist., Proc., vol. 3, p. 75

Figure 4

Foraminifera from the Pleistocene at Horse Cove (UCLA 4936), San Clemente Island, California.

1. *Cibicides fletcheri* GALLOWAY & WISSLER. a: spiral view; b: umbilical view; c: apertural view. UCLA Hypotype 34159. x 100. 2. *Rosalina globularis* D'ORBIGNY. a: spiral view; b: umbilical view; c: edge view showing aperture. UCLA Hypotype 34153. x 90. 3. *Cibicides fletcheri* GALLOWAY & WISSLER. The specimen is distorted because it was attached to a firm substrate during life. a: spiral view; b, c: edge views showing apertural opening from two views. UCLA Hypotype 34158. x 90 4. *Valvulineria* cf. *V. glabra* CUSHMAN. Side view. UCLA Hypotype 34156. x 200. Miocene? 5. *Pullenia miocenica* KLEINPELL. a: side view; b: apertural view. UCLA Hypotype 34157. x 140. Miocene? 6. *Rotorbinella campanulata* (GALLOWAY & WISSLER). This form has been called *Rotalia turbinata* CUSHMAN & VALENTINE. a: spiral view; b: umbilical view showing umbilical plug; c: apertural view. UCLA Hypotype 34151. x 140. 7. *Glabratella* sp. a: spiral view; b: umbilical view showing characteristic striations, which facilitate plastogamic reproduction; c: edge view. UCLA figured specimen 34152. x 200. 8. *Cribroelphidium poeyanum* (D'ORBIGNY). a: side view; b: apertural view, showing multiple openings characteristic of this genus. UCLA Hypotype 34154. x 90.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7b
7c
8b

CAECIDAE

Caecum californicum DALL, 1885, U. S. Nat. Mus., Proc., vol. 8, p. 541

Micranellum crebricinctum (CARPENTER). BARTSCH, 1920, Journ. Washingt. Acad. Sci., vol. 10, p. 678 = *Caecum crebricinctum* CARPENTER, 1864, Brit. Assoc. Adv. Sci., Reprt. for 1863, p. 655

VERMETIDAE

Petaloconchus complicatus DALL, 1908, Bull. Mus. Comp. Zool., Harvard, vol. 43, p. 326

Serpulorbis squamigerus (CARPENTER). CARPENTER, 1864, Brit. Assoc. Adv. Sci., Reprt. for 1863, p. 557 = *Aletes squamigerus* CARPENTER, 1856, Zool. Soc. London, Proc., p. 226

CERITHIIDAE

Bittium armillatum CARPENTER, 1864, Brit. Assoc. Adv. Sci., Reprt. for 1863; p. 655

Bittium sp. One small fragment of a *Bittium* with spiral threads similar to *B. eschrichtii* (MIDDENDORFF) was found.

CALYPTRAEIDAE

Crepidula sp.

COLUMBELLIDAE

Mitrella tuberosa (CARPENTER). GRANT & GALE, 1931, San Diego Soc. Nat. Hist., Mem., vol. 1, p. 697; plt. 26, fig. 45 = *Amycla tuberosa* CARPENTER, 1864, Brit. Assoc. Adv. Sci., Reprt. for 1863, p. 662

NASSARIIDAE

Nassarius (Caesia) fossatus (GOULD). ADDICOTT, 1965, U. S. Geol. Surv., Prof. Paper 503-B, explan. for plt. 2, figs. 5, 6 = *Buccinum fossatum* GOULD, 1849, Boston Soc. Nat. Hist., Proc., vol. 3, p. 152

OLIVIDAE

Olivella biplicata (SOWERBY). SWAINSON, 1840, Treat. Malac., pp. 133, 322, text fig. 3 = *Oliva biplicata* SOWERBY, 1825, Cat. Shells Tankerville, app., p. 33

CONIDAE

Conus californicus HINDS, 1844, Zool. Voy. Sulphur, vol. 2; p. 7; plt. 1, figs. 3 - 5

PELECYPODA

LUCINIDAE

Lucina californica CONRAD, 1837, Journ. Acad. Nat. Sci., Philadelphia, vol. 7, p. 255; plt. 20, fig. 1

VENERIDAE

Transennella tantilla (GOULD). DALL, 1902, U. S. Nat. Mus.,Proc., vol. 26, p. 384 = *Venus tantilla* GOULD, 1853, Boston Journ. Nat. Hist., vol. 6, p. 406; plt. 15, fig. 10

Saxidomus nuttalli CONRAD, 1837, Journ. Acad. Nat. Sci., Philadelphia, vol. 7, p. 249; plt. 19, fig. 12

MACOMIDAE

Macoma secta (CONRAD). H. & A. ADAMS, 1858, Genera Rec. Moll., vol. 2, p. 301 = *Tellina secta* CONRAD, 1837, Journ. Acad. Nat. Sci., Philadelphia, vol. 7, p. 257

OSTRACODA

CYTHERELLIDAE

Cytherella (Cytherelloidea) sp. A single immature valve, with much coarser pits than those on *C. (C.) californica* LEROY, was found.

BRACHYCYTHERIDAE

Brachycythere lincolnensis LEROY, 1943, Journ. Paleont., vol. 17, no. 4, p. 364; plt. 61, figs. 1 - 5, plt. 62, figs. 1, 2; text fig. 21 m

CYTHERURIDAE

Hemicytherura cf. *H. clathrata* (SARS). BENSON, 1959, Univ. Kansas, Paleont. Contr., Arthropoda, art. 1, p. 54; plt. 4, fig. 7 d; plt. 7, fig. 2; plt. 9, fig. 3

HEMICYTHERIDAE

Urocythereis glauca (SKOGSBERG) = *Cythereis glauca* SKOGSBERG, 1928, Calif. Acad. Sci., Proc., vol. 15, p. 110; plt. 3, figs. 2, 6, 7; plt. 6, fig. 4; text fig. 19. HAZEL (1962) noted that this species should be referred to *Urocythereis.*

Hemicythere jollaensis LEROY, 1943, Journ. Paleont., vol. 17, no. 4, p. 365; plt. 59, figs. 28 - 33; plt. 62, figs. 15, 16; text fig. 2 q

Hemicythere palosensis LEROY, 1943, Journ. Paleont., vol. 17, no. 4, p. 365; plt. 60, figs. 14 - 18; text fig. 2 c

Caudites? sp. An articulated pair of immature valves resembling *Caudites* in external shape but with less pronounced sculpture for that genus is present in the collections from Horse Cove.

TRACHYLEBERIDIDAE

Hermanites kewi (LEROY). BOLD, 1953, Micropaleont., vol. 3, no. 3, p. 240 = *Cythereis kewi* LEROY, 1943, Journ. Paleont., vol. 17, no. 4, p. 369; plt. 60, figs. 24 - 27; plt. 62, figs. 9, 10; text fig. 2 d. This species

is known from Pliocene and Lower Pleistocene deposits of southern California, and from the Lower Miocene (?) in Trinidad (Bold, 1957). It has not been reported to be living.

ECHINODERMATA

CLYPEASTEROIDA (class)

Dendraster sp. A small fragment, probably of *D. excentricus* (Eschscholtz), was found at the Horse Cove locality.

CENTRECHINOIDA

Strongylocentrotus sp. Spines and plates, referable to this genus, are abundant in the deposit.

MAMMALIA

CETACEA (order)

A single left delphinid periotic, resembling those of species of the genus *Lissodelphis* (E. D. Mitchell, personal communication), was found.

LOCALITY DESCRIPTION

UCLA 4936 is at the head of a small tributary trending northwest from Horse Creek, approximately 1425 feet N19°W of the mouth of Horse Creek, San Clemente Island, Los Angeles County, California. USGS San Clemente Island, South Quadrangle, 1950 edition. Collected by Jere H. Lipps and Edward D. Mitchell, Jr., September 7, 1961. JHL 130-61.

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